

VIII.—*Of the Pith of Plants.* By the Rev. PATRICK KEITH, F.L.S.

THE pith, as every body knows, is that soft and spongy substance which occupies the centre of the vegetable column, in which it is inclosed as in a sheath. In some plants it is close and compact, as in the willow; in others it is loose and interrupted, as in the walnut; in some its diameter is large in proportion to that of the trunk, as in the fig and elder; in others it is very small, as in the oak and elm. Much has been said concerning its functions, and many opinions have been hazarded.

But the only points of view in which I mean to regard it at present are, *first*, the extent to which it may be said to occupy the centre of the plant; and *secondly*, that of its diminution or obliteration in aged subjects.

1st. Does the pith occupy the root or any part of the root, as well as the stem and branches? Before we proceed further, it will be well to circumscribe the limits of the terms root and stem.—“That part of the axis which forces its way downwards, constantly avoiding light, and withdrawing from the influence of the air, is the descending axis or root; and that which seeks the light, always striving to expose itself to the air, and expanding itself to the utmost extent of its nature to the solar rays, is the ascending axis or stem.” Such is the definition of Dr. Lindley (Intro. 45.) with which we rest content.

Now though it seems to have been the opinion of the earlier botanists that a pith is present in the root of all plants as well as in the stem; yet M. Dutrochet, (*Recher. Anat.* p. 13.) with some other modern botanists, deny its existence in the root of exogens altogether.

With a view to satisfy myself on this point I began in 1836 to look out for subjects of inspection. I cannot say that I met with anything that could be fairly called a pith in the roots of full-grown or aged trees. I thought I had perceived a pith in the root of a plant of *Berberis communis*, which I inspected many years before the period above stated, with a different object in view; but as it was merely a matter of recollection, I

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laid no stress upon it, but proceeded in pursuit of a pith to examine the roots as well as stems, not of aged trees, but of young seedlings.

Accordingly, on the 24th of June 1836, I took up a seedling of the sycamore, *Acer Pseudoplatanus*. The stem measured about *three inches* in height. It was still furnished with its seed leaves, which were elevated about *two inches* above the level of the soil, with a pair of terminal stem leaves two inches in length by one and a half in breadth, and with a second and immature pair protruding from their axils. On a horizontal section it exhibited a circular layer of bark and a circular layer of woody fibre, enclosing a central pith conformable to the terms of the definition as it regards the ascending axis, or stem, which on being partly cut and partly broken asunder, exhibited also spirals both above and below the seed leaves. On the same day I took up a seedling of the beech tree, *Fagus sylvaticus*. The seed leaves were still attached to it and were fully expanded; and the stem on the horizontal section was divisible into bark and bundles of woody fibre, together with a central pith and spirals.

All this is what was to be expected; and the next thing remaining to be done was the inspection of the roots of the said seedlings which was now undertaken. In the above specimens this root measured from two to three inches in length, with a good many lateral fibres, and on a horizontal section exhibited, like the stem, a bark, a circular layer of woody fibre, but without spirals, and a central or axial mass, which mass differed in nothing visible from the central mass of the stem, whether as relative to its colour or to its spongy and cellular texture. On this account I have no hesitation in pronouncing it to be a true and legitimate pith, though lodged in the descending axis. If it be said, that owing to the elevation of the seed leaves in the above cases, the place of the collum must have been rendered doubtful, and that of the commencement of the real root uncertain, then I will present a case from which doubt is altogether excluded.

On the 15th of July, 1836, I stumbled on a seedling of *Corylus Avellana*. I took it up with much care and found that the seed lobes and half of the investing shell were still attached

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On the 15th of July, 1836, I stumbled on a seedling of *Corylus Avellana*. I took it up with much care and found that the seed lobes and half of the investing shell were still attached

to it. The stem measured seven inches in length, with three or four leaves. The root measured three or four inches in length, with many lateral fibres; and the diameter of the plant, at the widest, was about one eighth of an inch. In taking a longitudinal section of a portion of the root and stem so as to pass through the *collum*, which could not be mistaken, as the lobes never rise above the level of the soil, it was evident that the pith, strictly cellular and under the aspect of a fine thread, descended into the root, without any node or interruption or breach of continuity whatever, and without any appreciable difference beyond that of colour. Above the *collum* it was of a deep red; below it was of a pale green. If any doubt remains in the mind of the reader as to the accuracy of this statement, I shall be very glad if he will have the goodness to repeat the experiment on a seedling of the same species and of the same age, and to say what he thinks of it then. With regard to myself, I hold it to be a most satisfactory proof of the existence of a pith in the descending axis even of exogens. It may be seen equally well in the root of seedlings of the oak and ash, but without the peculiarity of the red and green colours.

2ndly. The other debateable point on the subject of the pith is as follows:

Does the pith, after having reached its maximum of diameter and parted with its specific juices, ever shrink further in its dimensions, whether by the generation of longitudinal fibres within it, or by pressure from without, or by any other cause? In the earlier days of botanical inquiry, it was the opinion of phytologists that the pith is obliterated with age, or at least much diminished in its diameter. This opinion was advocated by Mirbel in his '*Physiologie Végétale**', where he not only states the fact, but explains how, in his opinion, the change is effected,—that is, by being converted, first, into longitudinal tubes and then into wood. But on the contrary, there are botanists who contend that "the pith undergoes no change after the end of the first year of its growth;" at which period it may be said to have become distinctly cellular, and

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altogether, or nearly, dry. They add, that the fact of the great discrepancy of dimension between the pith of the primary shoot of the elder and that of the shoots of after years, so often quoted as an evidence of the shrinking of the pith, is an argument founded altogether in error, as the pith of the primary shoot from seed never was more than a mere thread*. Yet the question is not whether the pith of the shoot of future years does ever shrink to the diminutive size of the shoot of the first year from seed; but, rather, whether the pith of any shoot, be it primary or be it secondary, does ever shrink in any sensible or perceptible degree after the end of a year's growth, when its juices, as it seems, may be said to be exhausted. On the 1st of June, 1836, I separated from the stool of an ash-stock a stem of three years growth. It measured about nine feet in height, the growth of each year being distinctly marked, and measuring each about three feet in length. The upper shoot, that is the shoot of 1835, had a diameter of $\frac{3}{8}$ ths of an inch, with a pith of $\frac{1}{4}$ th at the widest. The middle shoot, that is the shoot of 1834, had a diameter of $\frac{7}{12}$ ths of an inch, with a pith of $\frac{1}{6}$ th; and the lower shoot, that is the shoot of 1833, had a diameter of $\frac{7}{8}$ ths of an inch, with a pith of $\frac{1}{10}$ th. Now as the shoots of the several years were equally luxuriant, and the youngest a year old, the pith ought, by hypothesis, to have been of the same dimensions in all of them. Yet it was gradually smaller and smaller from the youngest to the oldest; though it was undoubtedly of equal diameter in the first year's growth of each. For the shoot of a single year, from a different stock, gave a diameter of pith equal to that of the upper shoot of the above stem; and poles of twelve years old gave still a diminishing diameter when inspected towards the base. Whence we infer that the pith keeps shrinking, from one cause or other, long after the period of the first year's growth.

Since the above was written, it seems that several botanists of eminence have expressed themselves with regard to the preceding facts, in a way that seems to amount, either to a total denial of them, or to a persuasion that they are of too

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altogether, or nearly, dry. They add, that the fact of the great discrepancy of dimension between the pith of the primary shoot of the elder and that of the shoots of after years, so often quoted as an evidence of the shrinking of the pith, is an argument founded altogether in error, as the pith of the primary shoot from seed never was more than a mere thread*. Yet the question is not whether the pith of the shoot of future years does ever shrink to the diminutive size of the shoot of the first year from seed; but, rather, whether the pith of any shoot, be it primary or be it secondary, does ever shrink in any sensible or perceptible degree after the end of a year's growth, when its juices, as it seems, may be said to be exhausted. On the 1st of June, 1836, I separated from the stool of an ash-stock a stem of three years growth. It measured about nine feet in height, the growth of each year being distinctly marked, and measuring each about three feet in length. The upper shoot, that is the shoot of 1835, had a diameter of $\frac{3}{8}$ ths of an inch, with a pith of $\frac{1}{4}$ th at the widest. The middle shoot, that is the shoot of 1834, had a diameter of $\frac{7}{12}$ ths of an inch, with a pith of $\frac{1}{6}$ th; and the lower shoot, that is the shoot of 1833, had a diameter of $\frac{7}{8}$ ths of an inch, with a pith of $\frac{1}{10}$ th. Now as the shoots of the several years were equally luxuriant, and the youngest a year old, the pith ought, by hypothesis, to have been of the same dimensions in all of them. Yet it was gradually smaller and smaller from the youngest to the oldest; though it was undoubtedly of equal diameter in the first year's growth of each. For the shoot of a single year, from a different stock, gave a diameter of pith equal to that of the upper shoot of the above stem; and poles of twelve years old gave still a diminishing diameter when inspected towards the base. Whence we infer that the pith keeps shrinking, from one cause or other, long after the period of the first year's growth.

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little importance to merit any particular consideration, or at the least, that they are not new,—maintaining that wherever pith occurs, it occurs as an adjunct of stem and not of root. But with all due deference to great names and to great men, I contend most zealously for the fact of the existence of a pith in the root of exogenous seedlings at least. The affirmation of it is good, at any rate, as far as my induction goes; and no one is at liberty to deny it, unless he can show that he has examined roots of the same species and of the same age, without having been able to discover the same appearances. Nor is any one at liberty to say that the pith which is found in the root is of no importance because it occurs merely in seedlings and disappears in the mature plant. As well might the zoologist deny the importance of the tail of the tadpole, because it disappears in the full-grown frog. And if it is said that my facts are not new, I can only answer for myself, by saying in reply, that I never either heard or read of such facts till I discovered them in the course of my own investigations. They may be old facts; but if facts at all, whether old or new, why are they contradicted by modern botanists?

I contend also with equal zeal for the fact of the gradual diminution of the pith of the stem till it dwindles away at last to a mere thread in the mature trunk; and as I am persuaded that the facts which I have adduced in support of the doctrine are new, so I am satisfied that they are also true. Yet truth does not always meet with the ready reception which it merits—not even from philosophers themselves; especially when any new fact occurs that happens to militate against their recorded opinions.

IX.—*Remarks on some Species of the Genus Syngnathus.*

By WILLIAM YARRELL, Esq., F.L.S., F.Z.S.

WHEN reading in November last in the 8th Number of the 'Annals of Natural History' the translation of the paper on the species of the genus *Syngnathus* by M. B. Fr. Fries of Stockholm, in which that gentleman states that the first example of the ophidial pipe-fish figured in the 'History of the

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